Headquarters U.S. Air Force

Integrity - Service - Excellence

A Future Vision for Remotely Piloted Aircraft
Leveraging Interoperability and Networked Operations

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Alexandria VA

U.S. AIR FORCE

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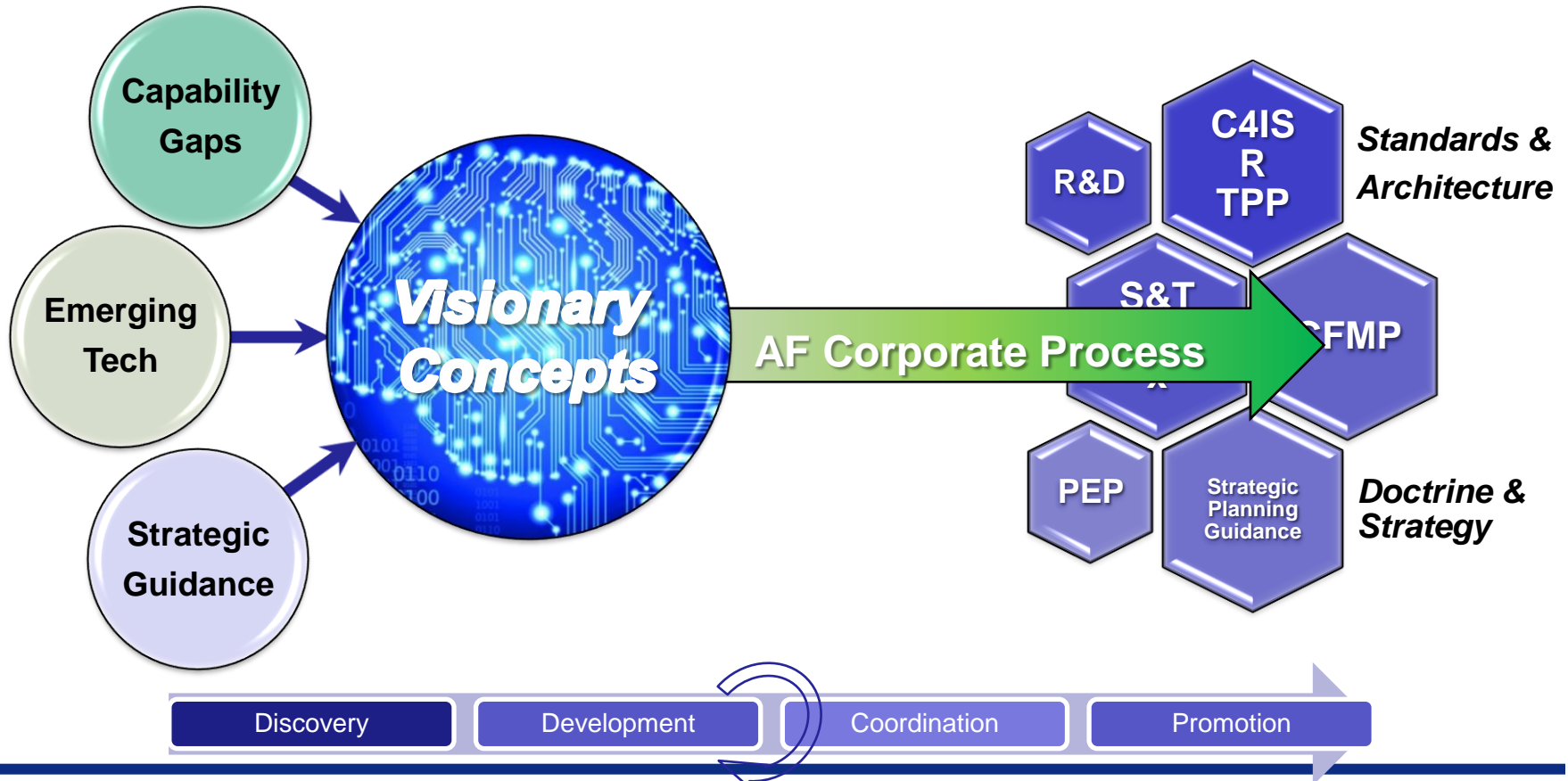**Standard Form 298 (Rev. 8-98)**
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AF A2 S&T Office

VISION: Collaboratively develop and coordinate strategic S&T visions and plans to support the future Air Force ISR Enterprise and its integration with partners and customers.

Injecting Visionary Concepts Into Today's Fight And Tomorrow's Programs

Capability Gaps

Emerging Tech

Strategic Guidance

Visionary Concepts

AF Corporate Process

R&D

C4ISR TPP

S&T

PEP

Strategic Planning Guidance

CFMP

Standards & Architecture

Doctrine & Strategy

| Discovery | Development | Coordination | Promotion |

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Key ISR Platform Challenges

- **Growing Demand**

  - **…for Intelligence, Surveillance, and Reconnaissance (ISR) Information**

  - **Diverse portfolio of fielded platforms**

- **Increasing Complexity**

  - **Sensors, Communications, and Processing**

  - **New phenomenologies, analysis methods, and visualization**

  - **Developing open standards & distributed processing capabilities**

- **Fiscal Constraint**

  - **Increased emphasis on improving/recapitalizing legacy systems vs. developing new capability**

- **Highly Contested Environments**

  - **Shift in focus from permissive environments**

  - **Rapidly fielded advances have not yet been normalized**

Sensors as a Service

Sensors:

- Increases in resolution and coverage can serve multiple needs
- Must reduce Size, Weight, and Power (SWaP)
- Increased on station times and OPTEMPO have reliability impacts
- Need for frequent technology insertion

Communications:

- Data density drives need for improved compression and onboard processing
- More consumers = spectral congestion
- Need for protected / agile communication

Processing, Exploitation, Dissemination:

- Immense volume of data
- Improve automated analysis and onboard processing blended with offboard skilled tradecraft analysts
- New data architectures and cross-domain federation to allow sharing of data
- Interoperability –legacy stove-piped designs must be integrated

RPA Vector Overview

UNITED STATES AIR FORCE
RPA VECTOR
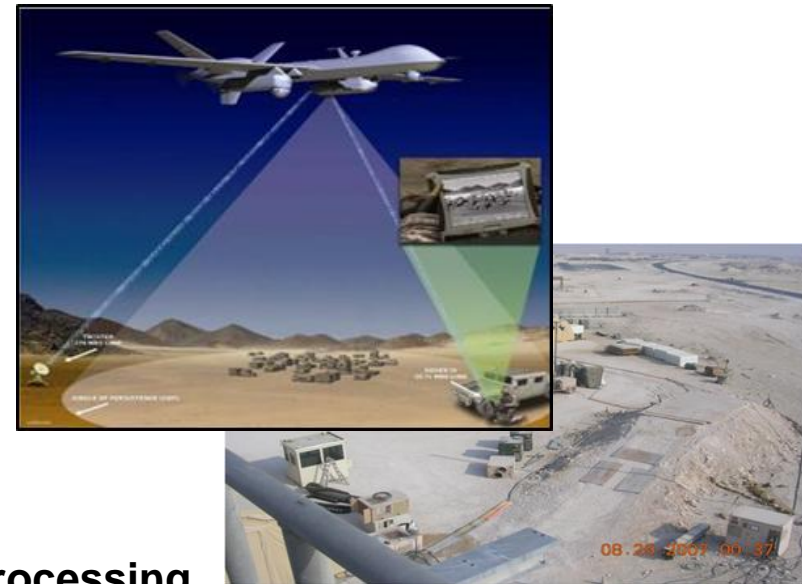
Vision and Enabling Concepts 2013 - 2038
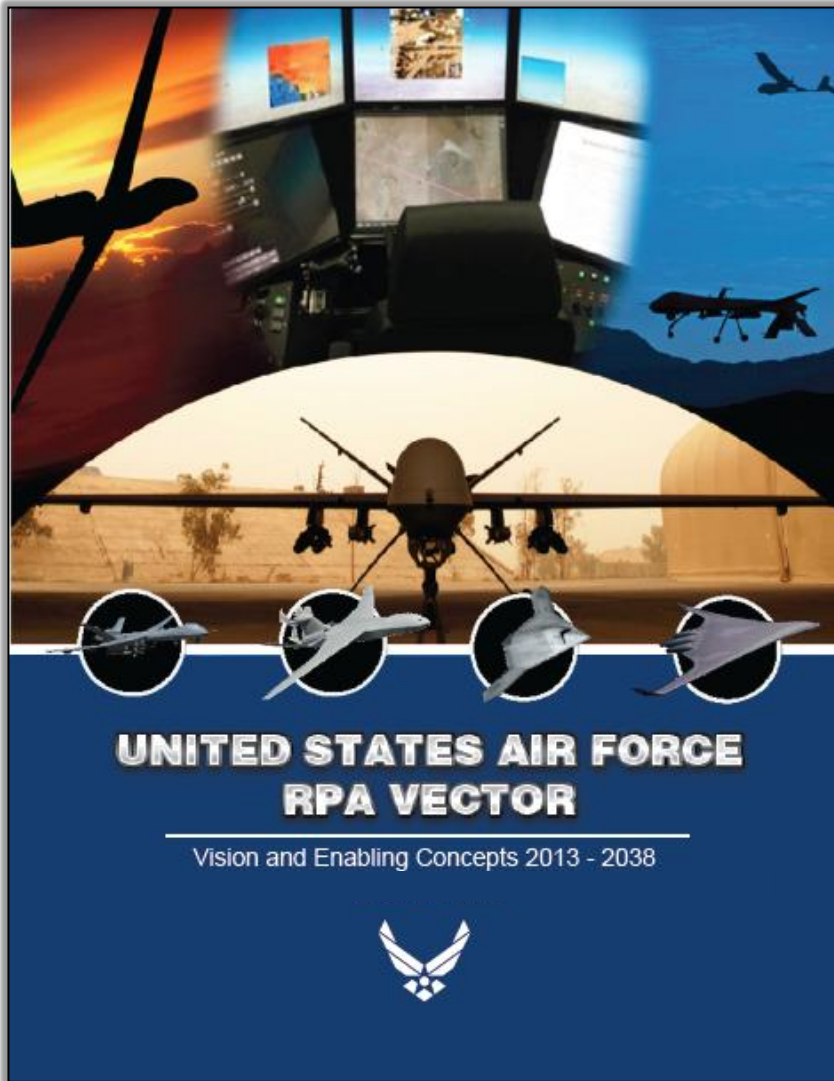
- **Headquarters Air Force is currently reviewing the "USAF RPA Vector: Vision and Enabling Concepts, 2013-2038"**
- **Describes emphasis areas for growth and development over the next 25 years**
  - **Balances the effects envisioned in the USAF UAS Flight Plan with the reality of constrained resources and ambitious national strategy for a complex world.**
  - **Opens the aperture beyond current austere fiscal realities to explore art of the possible technologies in the 2013 - 2038 timeframe.**
  - **Recognizes the shift toward a smaller more adaptable military**
  - **Notes the strategic shift from counter insurgency and permissive operations to the Asia/Pacific region**
  - **Cost-effective capabilities that directly support the National Defense Strategy will have the highest priority**

Partnership across departments and agencies, Joint and Coalition, Academia and industry, to drive innovation, technology and efficient use of R&D investments
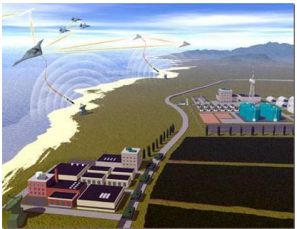
NextGen theater-level unmanned systems must detect, avoid, or counter threats – operating from permissive to highly contested access in all weather, maintaining persistent collections in the target / objective area

Force multiplication will be realized from networked control, swarming, and teaming where groups of flexibly autonomous vehicles operate in support of both manned and unmanned units in all types of battlespace

Aircraft acting as "loyal wingman" of manned aircraft may be used to conduct penetrating and persistent ISR, air interdiction, SEAD, defensive counter air, C2 of SUAS, or act as "weapon mules"
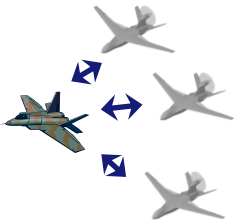
Increased interoperability through advancements in redundant and secure C2 infrastructure, open architecture, standards, and modularity
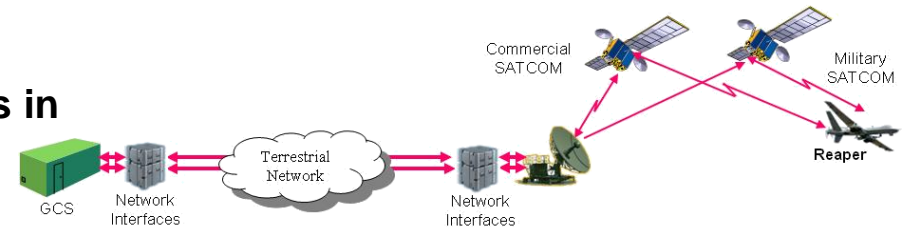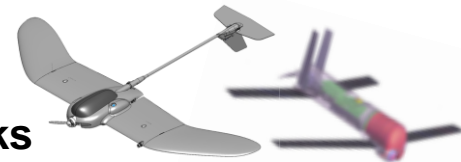
Expanded Small UAS Vision

- **Special Tactics Employment**
    - **Integrated Organic ISR/Strike Family of Systems**
    - **Open Architecture, Common GCS, Secure Data Links**
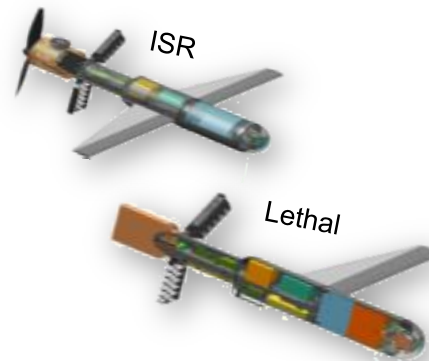   - **Dedicated Operators, Reduced Workload**

- **Special Tactics ISR**
    - **World Wide Deployable, Rapid Reaction Group II/III SUAS Unit**
    - **Light Footprint, Low Cost ISR Option**
    - **Networked Autonomous C2 System**

- **Air-Launched SUAS**
    - **Common Launch Tube – Expendable**
    - **Dual Ops from Air/Ground**
    - **ISR and/or Strike Options**
    - **Denied Area Penetration**

ISR

Lethal

Keys to Achieving This Vision

- **Integrated manned and unmanned systems**

  - **Seamlessly integrated across the full range of military operations**

  - **Future threats will necessitate an integrated force structure of manned and unmanned systems to mitigate risk**

- **Flexible Autonomy**

  - **Research in autonomous behaviors and human supervisory control promise enormous efficiencies as well capability increases as through teaming and multi-vehicle operations**

- **Open Architecture and Standards**

  - **Enables modularity and interoperability resulting in increased operational effect, adaptability, sustainability, extensibility, and potential reduced cost**

- **Secure, robust, agile, redundant C2 and information distribution**

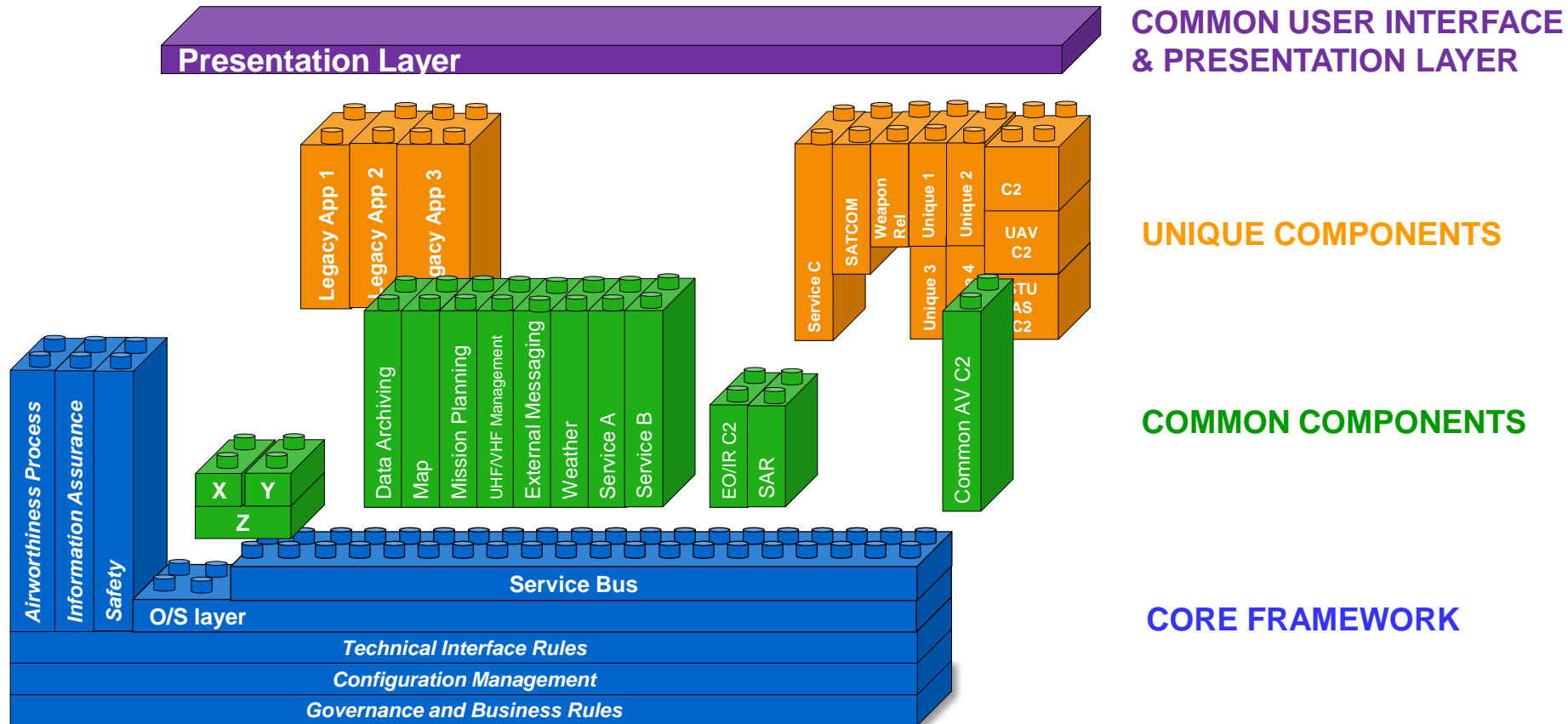 - **Essential for mission success in all environments and domains**
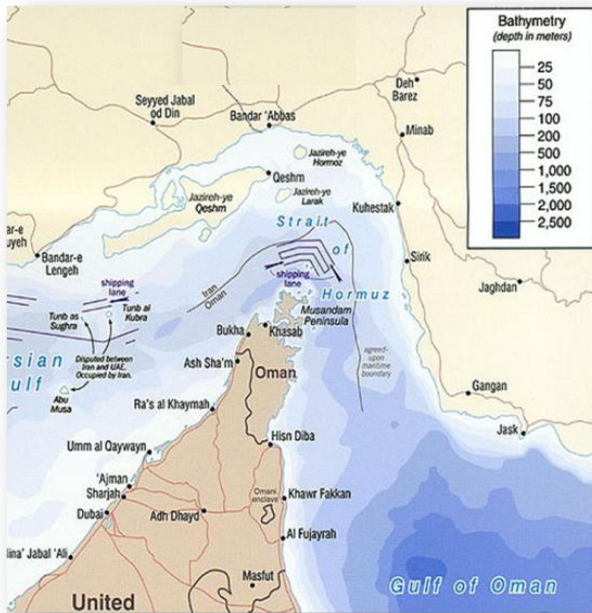
Control Station Considerations

- **Common Control System Architecture**
  - **Capable of operating a range of platforms**
  - **Allows for multiple mission-optimized interfaces**
  - **Enhances interoperability within a service as well as across Joint and Coalition forces, networks, and domains**
- **Key Attributes to Consider:**
  - **Layered Modular Framework (O/S, Network, Middleware, Interface)**
  - **Interfaces to external services for data consumed and published**
  - **Consistent user interfaces to maximize operator situational awareness & streamline training, yet adaptable to mission need.**
  - **Scalable with common and unique services**
- **Leverage existing infrastructure to the maximum extent**
- **Government must own the architecture and interface standards allowing best of breed proprietary modules.**
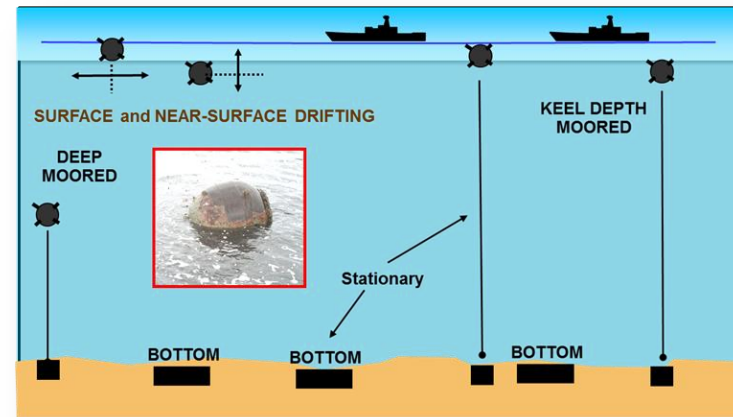
Notional Common Architecture

COMMON USER INTERFACE & PRESENTATION LAYER

Presentation Layer

UNIQUE COMPONENTS

Legacy App 1 · Legacy App 2 · Legacy App 3

Service C · SATCOM · Weapon Rel · Unique 1 · Unique 2 · Unique 3 · Unique 4 · C2 · UAV C2 · GTU AS C2

COMMON COMPONENTS

Data Archiving · Map · Mission Planning · UHF/V/HF Management · External Messaging · Weather · Service A · Service B

EO/IR C2 · SAR

Common AV C2

X · Y · Z

CORE FRAMEWORK

Airworthiness Process · Information Assurance · Safety

Service Bus

O/S layer

Technical Interface Rules

Configuration Management

Governance and Business Rules

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Vignette: UxS Countermine

Complex Environment of Air, Surface, and Subsurface threats
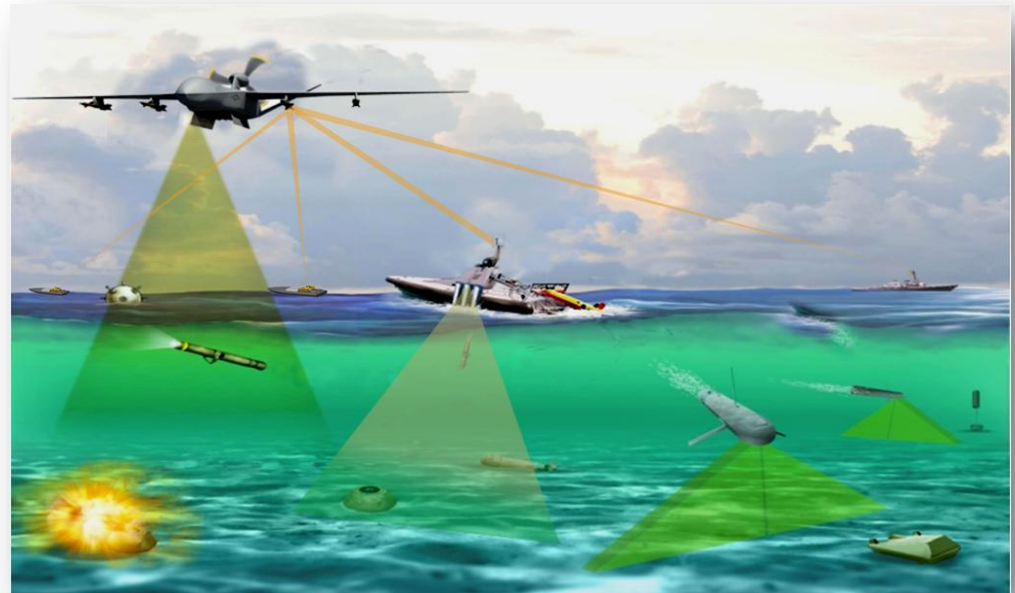

Strategic Shipping Channel
- 180 km long, 45 km wide
- 10 km wide traffic lane
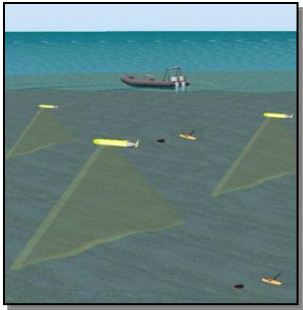- 35% of world seaborne oil
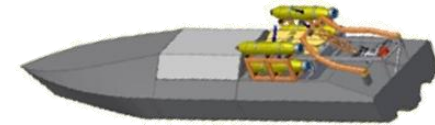- Avg 14 Tankers per day

# *Cross Domain Collaboration*

Unmanned Underwater Vehicles

▸ Hunter UUV cooperatively search, acoustically linked to USV and Killer UUV
▸ Detections passed to Killer UUV for positive identification
▸ Sensor data relayed to USV for relay to operations center

Unmanned Surface Vehicles

▸ USV and multiple UUV form automated team
▸ Tender can launch, recover and refuel UUVs
▸ USV can performs surface search and shallow mine detection
▸ Sensor data relayed to operations center via UAV
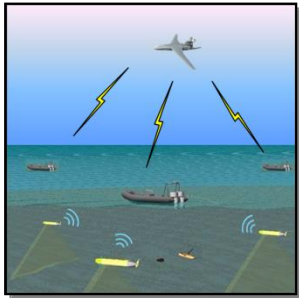
Unmanned Aircraft

▸ Communication link for multiple USV led teams
▸ Relay to and from operations center
▸ Onboard sensors contribute to surface search and provide early threat warning
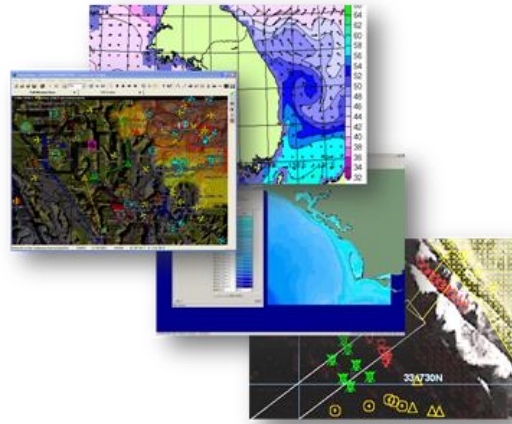▸ Onboard weapons provide defensive support
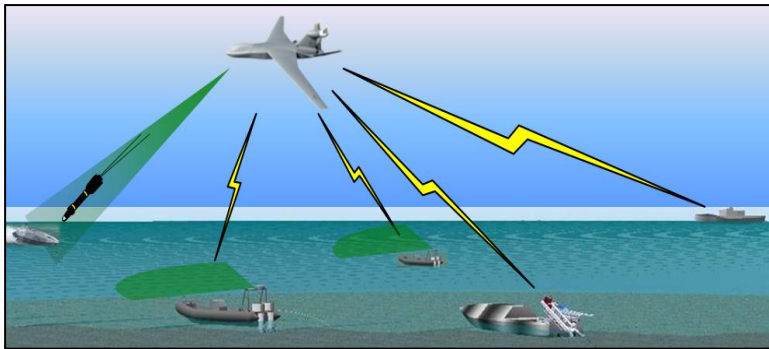
Mission Management Concept

Task Control Handoff – Overloaded or departing watch team members can hand off some or all tasks to any other workstation

Live Evaluation – Evaluator or Operations Supervisor can access data from any workstation

Mission Support – Access to essential mission planning information, sensor analysis and mission collaboration tools
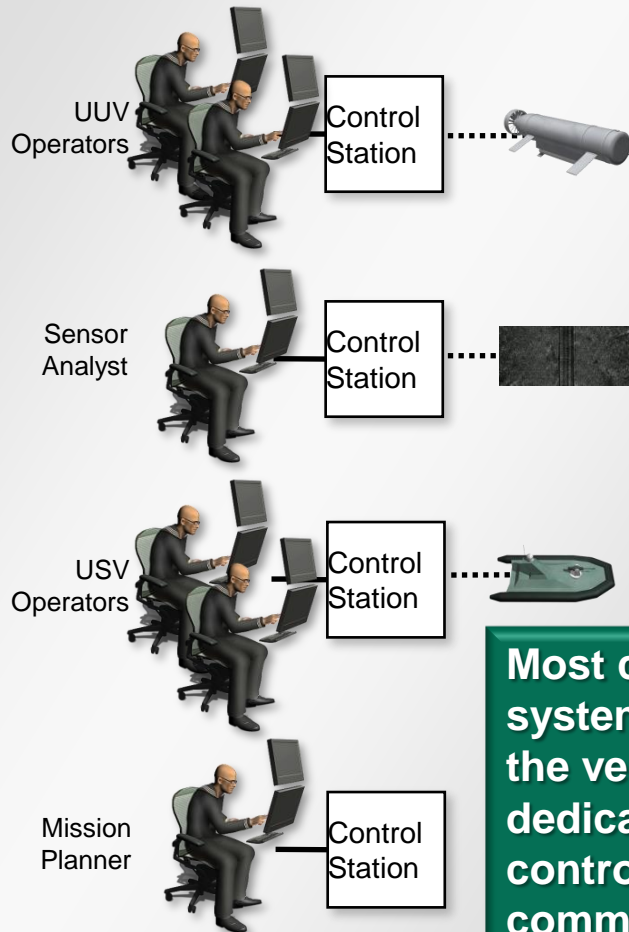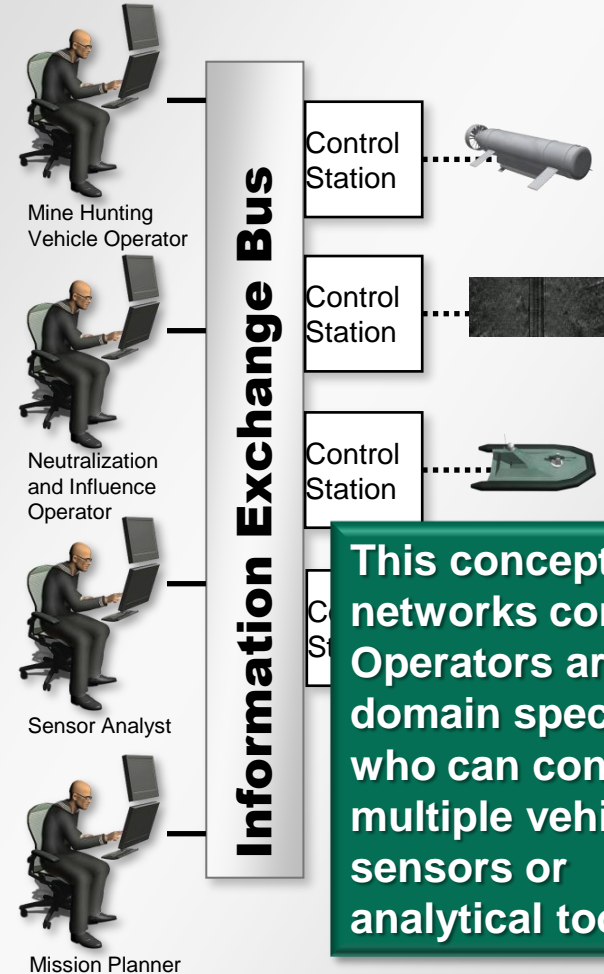
Inactive

Evaluator

Hunter UUV

USV

Killer UUV

Post-Mission Analysis
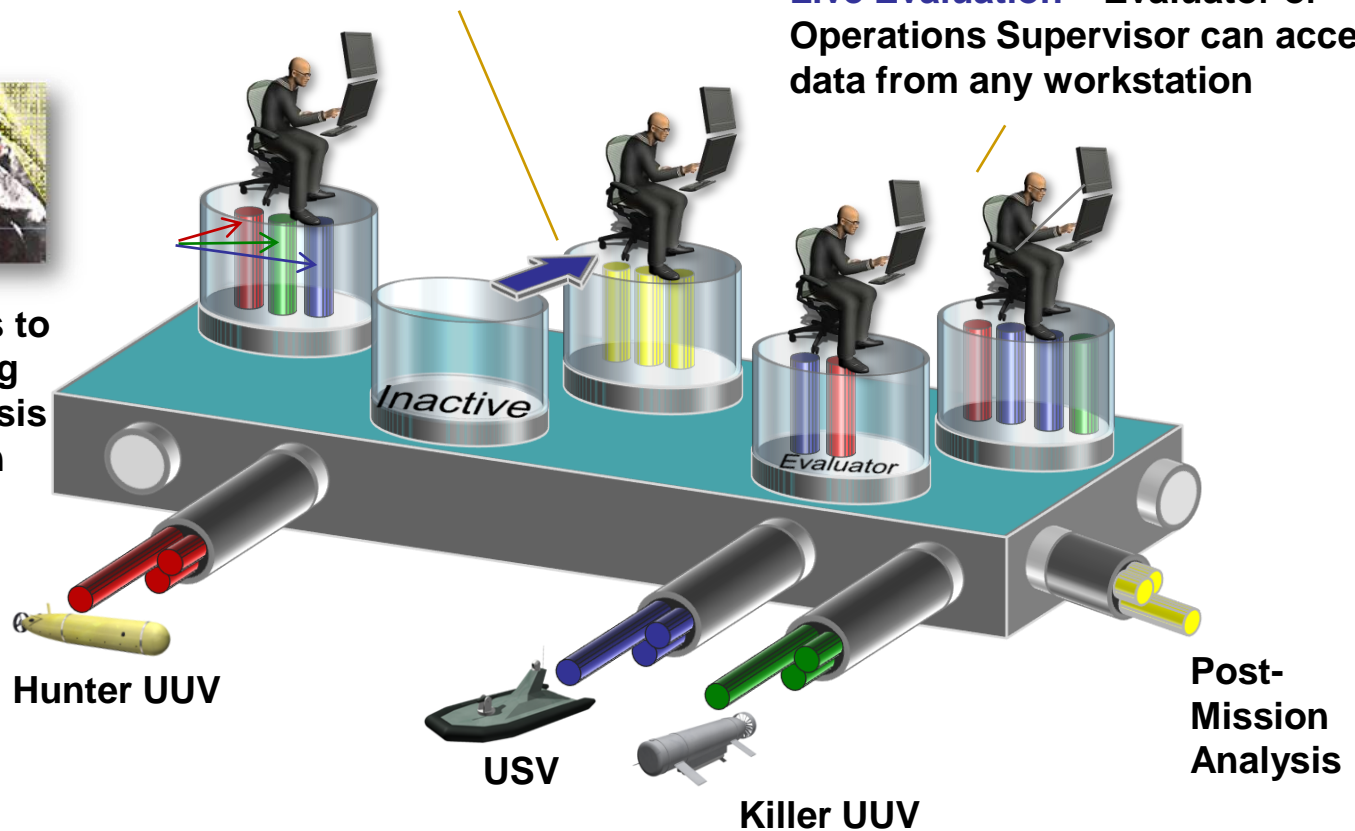
* From ONR Summit initiative

Improved Reallocation / C2

Current Coupled Tasking

UUV Operators — Control Station

Sensor Analyst — Control Station

USV Operators — Control Station

Mission Planner — Control Station

Most current systems focus on the vehicle with a dedicated crew, control stations, and communications

Future Task Reallocation

Mine Hunting Vehicle Operator

Neutralization and Influence Operator

Sensor Analyst

Mission Planner

Information Exchange Bus
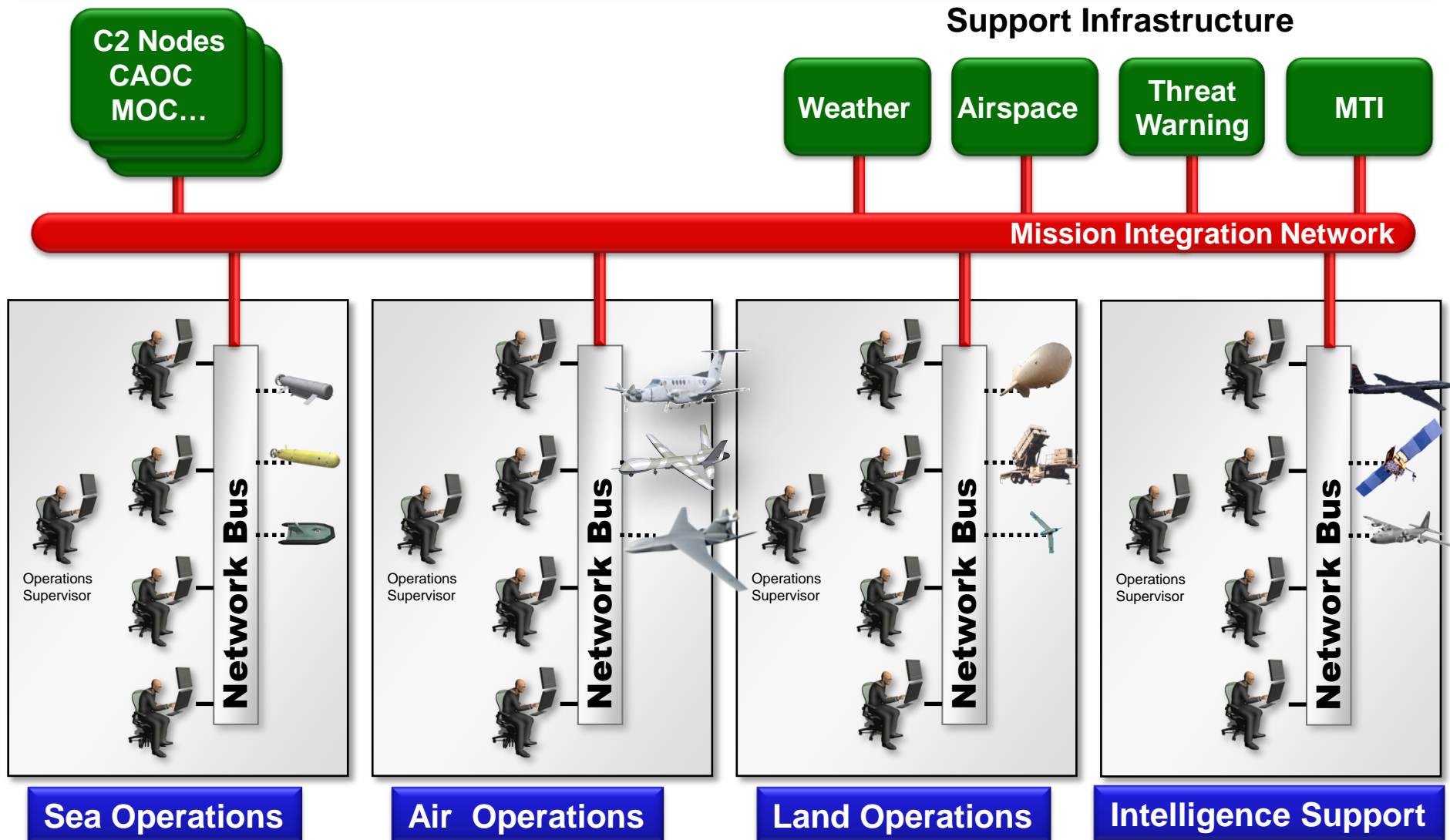
Control Station

Control Station

Control Station

Control Station

This concept networks control. Operators are domain specialists who can control multiple vehicles, sensors or analytical tools.

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Networked Operations

Support Infrastructure

C2 Nodes CAOC MOC…

Weather **Airspace** **Threat Warning** **MTI**

Mission Integration Network

Operations Supervisor — **Network Bus** — **Sea Operations**

Operations Supervisor — **Network Bus** — **Air Operations**

Operations Supervisor — **Network Bus** — **Land Operations**

Operations Supervisor — **Network Bus** — **Intelligence Support**

- **Unmanned systems have had explosive growth over the past decade but many challenges remain**

- **Current fiscal constraints drive need for increased modernization and technology insertion into existing platforms**

- **Government owned and enforced standards, interoperable architectures, and networked operations have the potential to provide increased capability to the warfighter and to synergize force structures across domains**

- **Shift the mindset from one domain, one vehicle, one service to a network of mission managed vehicles that leverage human-supervised autonomous behaviors to reduce workload and improve mission effectiveness**

QUESTIONS ?